Rhodora

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A MONOGRAPHIC STUDY OF ARABIS IN WESTERN NORTH AMERICA

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In *Arabis*, one of the larger genera of the *Cruciferae*, the excessive variability of certain species and the lack of sharply defined diagnostic characters throughout have given it a reputation of being exceedingly complex. The speciation is especially complicated in the Cordilleran region of western North America which is one of the principal centers of distribution for the genus. Elsewhere, *Arabis* is represented mostly in the north-temperate regions of the world with special areas of species-concentration in Europe and Asia. An inadequate appreciation of the importance of *Arabis* in North America is evident in all general systematic treatments of the *Cruciferae*. Even in the late pretentious work of O. E. Schulz,[1] the American species were not sufficiently considered in setting up the sixteen sectional divisions. As a result, many of our species are not properly referable to any section.

Perhaps one reason why American species have been largely ignored by the creators of world-wide systems of plant-classification is the lack of an inclusive, detailed study of *Arabis* in which the species and their relationships have been carefully and accurately evaluated. Recently, Hopkins[2] has partly met the need by giving us a treatment covering eastern and central North America, but the larger task of dealing with the species of the western portion of the North American Continent has not been accomplished. The central object of the present study has been the preparation of a systematic account of *Arabis* to fill this gap, but natural variation and the phylogenetic relationships of the species have also received attention.

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[1] Engler & Harms, Pflanzenf. **17b**: 542–547 (1936).

[2] Rhodora **39**: 63–98, 106–148, 155–186 (1937).

Unlike many genera of plants with endless modifications of flower-parts, the flowers of *Arabis* are monotonously uniform. Even the fruits and foliage are alike in some species so that in many instances trivial structures must be elevated to a position of prominence in treating the species and their relationships. Fortunately there are a number of clearly discrete species in *Arabis* which have been available as points of reference in their respective circles of affinity. These species are guide-posts to limits of variation and definitive characters and afford a general basis for interpreting species of a less clearly defined nature. The practice of constantly referring to natural, clearly defined species for aid in clarifying those of some obscurity has been such a standard procedure in the present investigation that it is expedient to list some of the species used. These are *A. blepharophylla, A. cobrensis, A. Crandallii, A. crucisetosa, A. Cusickii, A. dispar, A. furcata, A. glaucovalvula, A. Koehleri, A. Parishii, A. perennans, A. platysperma, A. rectissima, A. Shockleyi* and *A. suffrutescens.*

The taxonomic history of *Arabis* has been carefully worked out and presented by Hopkins.[1] A further discussion of the subject is unnecessary. Except for one species, *A. petiolaris*, not included by Hopkins, this study is concerned with the native species of *Arabis* occurring west of the one hundredth meridian in North America. It is expected that the present paper will be used in conjunction with that of Hopkins so that wherever possible duplication of his work has been avoided.

The present work cannot be considered to be final. *Arabis* is too complex for that. However, as much data and experience as it has been possible to assemble over a period of half-a-dozen years have been directed toward a solution of the problems involved. Some species are inadequately known because the regions inhabited by them have not been botanically explored. Others should be studied genetically and cytologically to elucidate certain problems concerning them. Still others should be cultivated in various ecological situations in order to test their presumed plasticity. These methods of approach are beyond the possible scope of this investigation, but it is hoped they will eventually be utilized. Eighteen of the fifty-three species included in the present work have been grown continuously for two or three years. All flowered except *A. hirsuta* and *A. glabra* which grew vigorously for three years without producing flowering stems. The plant-cultures were grown from seed collected in the wild and have been used for observations on the ontogeny of the species and a certain amount of cytological investigation.

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[1] Op. cit. pp. 63–66.

Relationships with other Genera

The question as to how far usual or well understood generic limits may be stretched without causing a complete breakdown in established concepts is particularly pertinent in the *Cruciferae*. In this family, the genera as often constituted are not wholly natural. This is true because of the tendency to include species which claim one or perhaps a few characteristics in common with those obviously belonging with the generic type, but which differ sufficiently to be definitely discordant. Large genera often receive many species in which the relationships are dubious and thus over a period of years may become so heterogeneous as to be almost an absurdity. It is the business of the monographer to evaluate and place anomolous species. In studying *Arabis*, it has been my policy to check carefully the generic character of each species under consideration before placing it unequivocally in the genus. While doing so, as one might expect in a genus dating from Linnaeus, several species have been found to be quite out of place.

In America, the nearest related genus to *Arabis* is *Sibara*. In 1896, Greene[1] proposed the anagram *Sibara* as a generic name for a number of species with common characters previously placed by various authors in *Arabis*, *Cardamine*, *Sisymbrium* and *Nasturtium*. These species seemingly are more closely related to *Arabis* than to any other genus and, indeed, they have a number of characters in common with it. Greene failed to point out reliable differences between *Sibara* and *Arabis* and as a result many subsequent writers have not recognized his genus as a valid one. *Arabis* is related to *Sibara* through such species as *A. lyrata* and *A. arenosa* which belong to the so-called section *Cardaminopsis.* At least two recent students of the *Cruciferae,* von Hayek[1] and O. E. Schulz,[2] have given generic recognition to *Cardaminopsis.* I do not concur with them in the opinion that *Cardaminopsis* is a genus distinct from *Arabis,* but it must be admitted that *A. lyrata* and its relatives are not next door to *A. alpina,* the type of the genus. To add species to *Arabis* which are only remotely related, if at all, to *A. lyrata,* the latter being somewhere near the outer boundary of the generic limits, simply overruns the natural definitive lines of the genus. Such a practice carried to its logical conclusion in a family like the *Cruciferae* would only lead to the establishment of another absurd *Crucifera* as conceived by Krause.[3]

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[1] Pittonia 3: 10 (1896).

Sibara as a genus rests on the following characters which do not belong or belong only in part to *Arabis:* pectinate to pinnatifid, somewhat glaucous foliage; similar basal and cauline leaves; petiolate cauline leaves; annual or at very most biennial habit; absence of glandular tissue adjacent to the paired stamens; and the lack of an expanded pedicel-summit. The foliage of all the species of *Sibara* is highly dissected, varying from runcinate-pinnatifid to pectinate with many narrow divisions. This type of foliage is common in *Cardamine* and *Sisymbrium,* but is unknown in *Arabis* proper. The basal rosette is caducous or entirely absent in *Sibara,* but always the first formed leaves are similar to the cauline ones. In *Arabis,* a basal rosette is usually developed and in all cases the basal leaves are differentiated from the cauline. Such recent authors as von Hayek[4] and Villani,[5] among others, have stressed the configuration of the nectar-glands on the receptacle as being of fundamental importance in classifying the *Cruciferae.* It is undoubtedly

[1] Fl. Steiermark **1**: 477 (1908).

[2] Op. cit. p. 541.

[3] Sturm's Fl. Deutsch. **6**: 31–169 (1902).

[4] Beiheft Bot. Centralb. **27**: 127–335 (1911).

[5] Annali di Botanica **16**: 71–121 (1923).

true that they have overemphasized this character, since more variation in natural genera occurs than they have taken account of, but when used in conjunction with other characteristics, this feature is a useful tool to aid in clarification of generic lines. In *Arabis*, the glandular tissue of the nectaries is well-developed and surrounds the base of the single stamens, subtends or surrounds the base of the paired stamens, except in one small group, and often subtends or partially surrounds the base of each petal. *Sibara*, on the other hand, has poorly developed nectaries. The glandular tissue subtends or rarely almost surrounds the base of the single stamens in a thin mold, but is absent or obsolete elsewhere on the receptacle. The most noticeable difference between *Arabis* and *Sibara*, aside from the foliage, is the lack of an expanded pedicel-summit in the latter genus. *Arabis* always has the pedicel-summit expanded in such a way as to create an enlarged support for the receptacle and nectaries. On mature fruits, a rather abrupt narrowing from pedicel-summit to replum-base is evident. In *Sibara*, there is practically no change in diameter or only a slight gradual expansion between pedicel and replum-base. An obscure ring of sepal-, petal-, and stamen-scars and shriveled nectaries alone mark the outer part of the receptacle after mature siliques have been developed. Very small flowers and a branching habit give *Sibara* a habital symmetry which is distinctive in itself. Only one or two species of *Arabis* have flowers even approaching the small size of the largest flowers of *Sibara* and only a few species have a similar habital aspect.

The essential characters setting *Arabis* off from other genera possessing linear siliques are its accumbent cotyledons and siliques flattened parallel to the septum. One possible exception to the flattened siliques is found in *A. glabra*, but here the siliques are often somewhat flattened and are never more than semiterete. The nature of the siliques together with the distinctive creamy-yellow petals in *A. glabra* are used by some botanists, especially the European, to separate this species from *Arabis* as *Turritis glabra*. There can be no doubt but that *A. glabra* is somewhat related to *A. hirsuta* which it nearly parallels in distribution, and it seems preferable to retain it in *Arabis*.

In the related *Halimolobos*, the siliques are terete and the seeds have incumbent cotyledons. These points, together with the general habit, seem to place *Halimolobos* nearer to *Sysimbrium* than to *Arabis*. Several species, such as *A. Whitedii* and *A. Hookeri,* with terete siliques and incumbent cotyledons are now more naturally placed with *Halimolobos.*

Arabis is sometimes placed near *Cardamine,* but it is not believed that these genera are at all closely related. The peculiar elastic valves, opening with a relatively wide band of replum-tissue remaining on each side, is a distinctive feature of *Cardamine* and *Dentaria.* It should be stressed that the stamens of *Arabis* are always tetradynamous. This aids in distinguishing it from genera like *Thelypodium* where the single and paired stamens are of equal length.

Relationships of the Species

The systematic classifications of *Arabis* presented by DeCandolle,[1] Meyer,[2] Prantl,[3] Watson,[4] v. Hayek,[5] N. Busch,[6] and O. E. Schulz,[7] though almost successively more complicated in the chronological order given, do not satisfactorily allow for the inclusion of the North American plants without separating obviously related species into different sections. The weaknesses of these attempts to arrange systematically the species of *Arabis* into sections result from the fact that there are no clearly defined groups within the genus. Furthermore, many of the workers did not have sufficient material to insure an inclusive treatment. In the older works the lack of representative species was the penalty imposed by the immaturity of the science itself, but the recent students have been more fortunate in this respect. However, even with a quantity of material available for study, the difficulty resulting from the lack of clearly defined subgenera or sections cannot be overcome. It is my conviction that among the western American species of *Arabis* truly natural subdivisions of the genus other than the species themselves are nonexistent. For this reason I have arranged these species in

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[1] Syst. Nat. **2:** 214 (1821) and Prod. **1:** 142–148 (1824).

[2] Ledeb., Fl. Alt. **3:** 18–20 (1831).

[3] Engler & Prantl, Pflanzenf. **3:** 2 Abt. 192–193 (1891).

[4] Gray, Syn. Fl. N. Am. **1:** 159–167 (1895).

[5] Beih. Bot. Central. **27:** 204 (1911).

[6] Fl. Sib. et Orient. Ext. **4,** fam. **25:** 428–475 (1926).

[7] Engler and Harms, Pflanzenf. **17b:** 2 Aufl. 542–547 (1936).

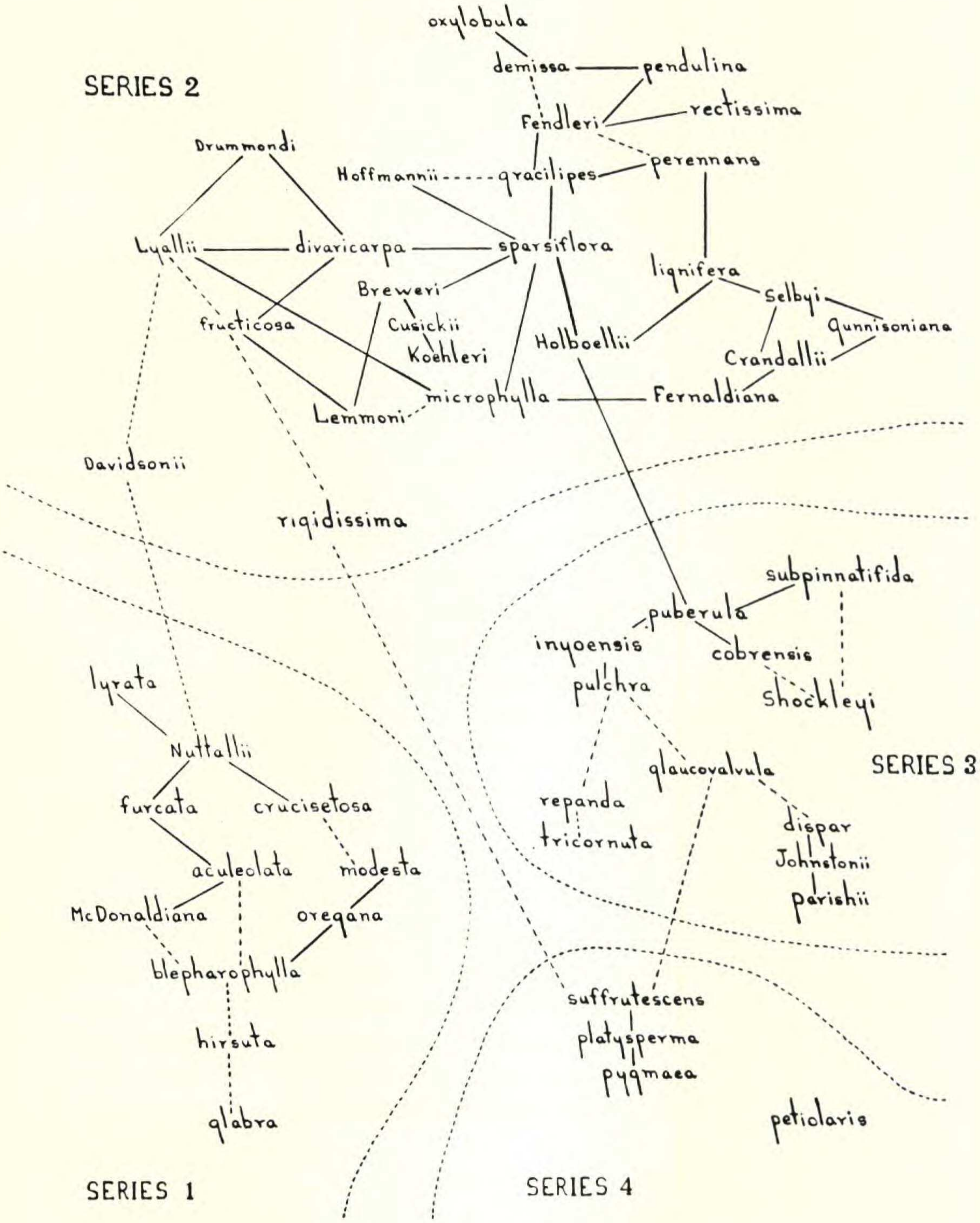

FIG. 1. Relationships in ARABIS

four more or less interrelated series of no specified taxonomic rank. It should be understood that these divisions do not correspond to previously published sections of *Arabis*, and are used primarily for the purpose of indicating probable circles of affinity. The four series are presented in chart form as FIG. 1. Solid lines between species indicate a rather close relationship, broken lines indicate a probable distant relationship.

SPECIES-CRITERIA

No single character, although it may appear to be very fundamental, can be solely relied upon positively to indicate relationships between species or to separate interrelated groups of species in *Arabis*. One group is likely to have the same or a similar interplay of characters as that found in another. A simple illustration of the point may be taken from the cases of *A. platysperma* and *A. suffrutescens*, whose close relationship to each other is obvious, and of *A. puberula* and *A. Shockleyi*, another related pair. The pedicel-position in one species of each pair is directly opposite that of the other. Thus, *A. platysperma* and *A. Shockleyi* have ascending pedicels, whereas *A. suffrutescens* and *A. puberula* have the pedicels reflexed. Taking pedicel-position as a criterion it is impossible to show that *A. platysperma* and *A. suffrutescens* are related but, when several characters are taken into account, the relationship is unmistakable. Numerous similar instances of parallel development in unrelated species and unrelated groups of species could be pointed out. This fact makes evident the necessity for great care in the evaluation of diagnostic characters. Furthermore, it is clear that a successful classification of *Arabis* must rest on a series of characters whose pattern has been carefully determined. In general, qualitative rather than quantitative differences are most reliable and should be given first importance in the characterization of the species.

HABIT.—Most species of *Arabis* are strictly herbaceous, but many possess a woody caudex. In perennial species the caudex and root persist in a dormant state throughout any period inimical to growth, and leaves arise from the apex of the caudex or caudex-branches with the return of favorable growing conditions. The caudex shows special development in such desert species as

A. pulchra and *A. perennans* in which it is much elongated. Using desert shrubs for support, the leaves and flowering stems of these plants are often held from one to several decimeters off the ground. A number of tufted perennials have a highly branched caudex which may or may not be subterranean. In such cases many of the caudex-branches bear only leaves, while others bear both leaves and a fertile stem. Usually some remnants of shed leaves are to be found upon the caudex. Sometimes these are of a characteristic nature, as in *A. Koehleri,* in which the leaf-bases resemble the peg-like pulvini found on old twigs of *Picea.*

The stems may be either simple or branched even within a given species. Certain species show a marked constancy in possessing simple fertile stems, while others constantly possess branched stems. Plants which have been grazed are usually branched even though a simple stem is the normal habit of growth. Whether the stems are branched near the base or toward the top markedly affects the general symmetry of the plant. Thus, the position of the branching is sometimes of importance in distinguishing between entities, but this feature is usually not constant and must be used with caution.

The tap-root system is characteristic of *Arabis,* but that alone does not indicate that all species are either biennial or perennial as Hopkins[1] seems to have presumed. The plant which he treated as *Arabis virginica* (it is here transferred to *Sibara*) was said to be biennial.[2] Two lots of this plant have been grown from seed to the flowering stage in less than three months at the Harvard greenhouses. This would seem to indicate that it is usually annual in spite of its having a tap-root. All species of *Arabis* included in the present paper are either biennial or perennial.

Foliage.—Two sorts of leaves are found in *Arabis.* Those of the flowering stems are differentiated from those at the base of these stems or those terminating sterile branches of the caudex. The term "basal leaves" used throughout this paper refers to the leaves found at the base of fertile stems, those terminating caudex-branches or on the root-crown. The term "radical leaves" has often been applied here but usually only the first year's rosette is truly radical. Leaves subsequently produced are not near the root in many cases but, strictly speaking, are stem-leaves, though different from the leaves of the fertile stem. The term "cauline leaves" is restricted to the leaves borne on the fertile stems.

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[1] Rhodora **39**: 67 (1937).

[2] Ibid. p. 80.

The size and shape of the leaves are variable, but extremes in either may be characteristic of certain species and are useful in their delimitation. The leaves are entire, dentate or rarely more highly dissected. These features, though variable, are useful when only extremes are considered. The strongly perennial species usually have entire or nearly entire leaves. Many species have cauline leaves with auricled bases, while in others no auricles are present. This feature has been widely used as a species-criterion but it is unstable and may be relied upon only in some cases.

The basal leaves are always petiolate, while the cauline leaves are only rarely so. In western America only four species with petiolate cauline leaves are known. The cauline leaves usually diminish in size from base toward apex of the flowering stem. The basal leaves are often caducous, hence they may not be present on mature plants, as in *A. canadensis* and *A. tricornuta.* However, most of the species in our area have the basal leaves present even in old plants.

Vestiture.—The trichomes of *Arabis* are single-celled and never glandular. They may be simple, bifurcate with branches appressed (malphigiaceous) or variously branched. The term stellate has usually been applied to trichomes of the *Cruciferae* with several to many branches. Most of the highly branched types are actually not stellate, if by that term is meant a centrally attached hair with branches radiating from the middle after the manner of a star. The severally branched trichomes commonly found in *Arabis* are nearly all of a dendritic type, i. e., with a central trunk and irregularly placed, elevated branches. These branches themselves often fork, giving rise to new branches, thus forming a tree-like configuration. The fact that truly stellate trichomes are common in the *Cruciferae* and other plant families has made it desirable to distinguish the tree-like hairs by applying to them the term dendritic.

The type of trichome, whether simple, malphigiaceous, stellate, dendritic, swollen at base, terete or flattened, is of considerable importance in characterizing many species. A few species have two kinds of pubescence, but the association is usually fairly stable. The significance of the size of trichomes is not fully understood. Large differences in size may be safely used in support of other characters, but within at least a few species the trichomes vary considerably in size. An unsuccessful attempt was made to correlate trichome-size with polyploidy in *A. divaricarpa*. Further data are needed to determine whether polyploidy has the same effect on trichome-size as on the size of cells and stomata.

The density and extent of the pubescence on plants of *Arabis* are ecologically plastic and vary seasonally. Though often used with a great deal of assurance, the mere presence or absence of pubescence is a weak criterion. Specific observations on this point are discussed in some detail under *A. Drummondi.*

FLOWERS.—In general the flowers are similar throughout *Arabis*. They are always tetradynymous. Large differences in size may be utilized in differentiating some species, while in others there is considerable variation and size-differences are not reliable. Measurements to be useful comparatively must include the limits of variation in the size of any given part or organ. When accurately determined and based on a sufficient sample of the total population of a species they may be highly reliable. Unfortunately, it is only in some cases that such a procedure can be followed by a taxonomist because of lack of material.

The inner sepal-pair of the *Arabis* flower is never saccate at base. However, the outer pair is sometimes slightly saccate and in a few instances markedly so. The character is only limitedly usable. Petal-color varies from a deep purple to white in *Arabis*. *A. glabra* alone has a slightly yellowish petal.

The nectar-glands in the *Cruciferae* have been shown to be diversely specialized and it has been contended that their form, position and extent of development are of importance in the classification of the family. Beginning with Hildebrand in 1879 and Velenovsky in 1883 the nectar-glands have received increased attention. They formed the chief basis for a system of the *Cruciferae* by Bayer[1] and were heavily relied upon by von Hayek[2] in his inclusive treatment of the family. In view of these facts, the glandular pattern in all species of *Arabis* included in the present paper has been carefully determined and diagrammed to see if this feature might be used as an aid in the characterization of species or species-groups. Contrary to the finding of Günthart,[3] where several types were found among European species, only two patterns were found. One type, in which the glandular tissue surrounds the base of the single stamen and is obsolete or entirely absent elsewhere on the receptacle, is confined to series one. In the rest of the species, the glandular tissue forms a continuous mold beneath all stamens and often has short projections flanking the petal-base. Thus it is clear that the glandular pattern is of no particular importance in any attempt to distinguish between the species themselves, although it may be used to some extent in separating groups of species.

SILIQUES.—The mature silique, as in other *Cruciferae,* is of paramount significance. The shape is, in general, narrowly linear with the valves strongly flattened parallel to the septum. An exception is the semi-terete capsule of *A. glabra.* Although the size of the silique is variable, there are recognizable limits to the variation and, if accurately determined, size becomes a useful tool in characterizing certain species. The central nerve of the valves is variously developed in different species, and a limited use may be made of this feature if it is carefully applied in conjunction with other characters. The cellular pattern of the septum is distinctive in a few species but, on the whole, it is so uniform and difficult of determination that little use has been made of it. The siliques of most species of *Arabis* are glabrous but in some they are always pubescent, while in a few species they may be either pubescent or glabrous.

Silique-position is constant in most species and the usefulness of this feature in determining species of *Arabis* is well known. However, in a few instances the siliques vary considerably in their position with respect to the rachis within a given entity. Among different species the siliques vary all the way from a strictly erect position to a closely reflexed one. The siliques may be straight, curved or even strongly bow-shaped. The presence or absence of an elongated style upon the mature silique is a character which may be trusted within certain groups. An unusual development of the style is found in *A. Parishii* and it is only slightly less prominent in *A. Johnstonii.*

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[1] Beih. Bot. Central. **18**: 119–180 (1905).

[2] Op. Cit.

[3] Reprint from Bibl. Bot. **77**: 1–36 (1912).

SEEDS.—The shape and size of the seeds and the absence or extent of development of wings are significant. Whether the seeds are in one or two rows in each locule has frequently been the basis for the segregation of species. Considering the point of attachment, the seeds are always in two rows, the attachment being at the point of replum-junction on both sides of the locule. In certain species the seeds do not enlarge to the full width of the locule, hence the seeds themselves appear to be in two rows. In other species, the seeds entirely occupy the locule-width and are then said to be in one row. The difference is not a morphological one and is more apparent than real in so far as the actual number of rows of seeds in each locule is concerned. It is clear, then, that it might be possible for the seeds to be in neither one row nor two, but half-way between. This is precisely what happens in some species. In others the character is very constant. It will be seen that the real significance is to be attached to the relationship between seed-size and silique-width. My use of the terms uniseriate and biseriate refers to the position of the seed rather than to the actual number of rows as determined by seed-attachment. The cotyledons are accumbent in all the species presented in the present paper.

GEOGRAPHICAL DISTRIBUTION

The geographical area occupied by each species dealt with has been carefully determined and mapped. Maps showing the distribution of all species and varieties not extremely localized, except the widespread *A. glabra* and *A. hirsuta,* are presented on several pages appropriately placed in the general treatment. Many more specimens than could be cited were included in the data assembled for the maps. These geographical data have been of considerable value in determining natural boundaries of the species and varieties. Where a question as to the distinctness or relationship of a variety or species has arisen, a comparison of the areas occupied by the related forms has usually been decisive. In addition to the horizontal area occupied by the species, the altitudinal zone in which they normally grow has been considered. The habitat and soil-preferences have also received attention whenever the data have been available. *Arabis* is indigenous to all the general habitats represented in the area, including high alpine and desert situations.

No one limited area in western America is conspicuous because of the number of endemic species of *Arabis* contained within it. The endemic species are quite generally distributed among the Rocky Mountains, Sierra Nevada Mountains, northern Coast Ranges in California, Siskiyou Mountains, Cascade Mountains and the deserts or lesser mountain systems in the intervening region. One species, *A. Hoffmannii,* is exclusively insular, being found only on Santa Cruz Island. Plants of the genus extend from Alaska on the north to northern Baja California on the south. Throughout the paper, where geographical distribution has been of special importance, it has been discussed under the species concerned. Many of the accompanying maps were based on Goode *Base Map* no. 102; by permission of the University of Chicago Press.

Cytology

In addition to the usual techniques employed in Systematic Botany, some species have been examined cytologically. As a result of these studies it has become clear that certain species usually considered to be highly complex taxonomically are apt to contain a polyploid series. *A. hirsuta* in America, *A. Holboellii, A. Fendleri* and *A. divaricarpa* are species of this type. Far more work is necessary before the variations and complexities of these species will be fully understood, but it is now definitely known that there are polyploid plants in all of them.

Results of the cytological examination of thirty-four collections of *Arabis* are presented in the table following, which contains chromosome-numbers for eighteen species and varieties. All but four are reported for the first time. The counts were made from material gathered directly at the locality given or from plants grown from seed collected at these stations. Except for one or two instances, specimens have been preserved and may be consulted at the Gray Herbarium under the number cited. Counts were made from pollen mother-cells, using aceto-carmine smears, or from root-tips, using a modification of Fuelgen's technique. Unfortunately, it has been impossible to obtain sufficient data to make more than one or two general statements concerning the cytology of *Arabis*. Although several interesting problems have arisen, their solution has not been attempted, but it is hoped they will be mastered during future work in the genus.

On the basis of Jaretzky's[1] report of the chromosome-numbers for ten species of *Arabis*, Manton[2] gave the number eight as the fundamental one for the genus. Recently, Frank H. Smith,[3] after finding six pairs of chromosomes in *A. dentata* and seven in *A. laevigata*, doubted whether eight was necessarily the basic number for the genus. A glance at the table below will show that a haploid number of seven is by far the commonest among the species investigated. Undoubtedly seven is to be considered one of the fundamental chromosome-numbers of *Arabis*.

CHROMOSOME-NUMBERS IN ARABIS

Species	Place of Collection	Collector and Number	N	2N
A. alpina	Harvard Botanic Garden, Cambridge	Rollins s. n.	8	16
A. alpina	Gaspé Co., Quebec	Knowlton s. n.		16
A. cobrensis	Uinta Co., Wyoming	Rollins 1656	7	
A. Crandallii	Gunnison Co., Colorado	Rollins 2093	7	
A. Crandallii	Gunnison Co., Colorado	Rollins 2084	7	
A. divaricarpa	Uintah Co., Utah	Rollins 1767	15	
A. divaricarpa	Larimer Co., Colorado	Rollins 2400	8	
A. Drummondi	Uintah Co., Utah	Rollins 1764	7	
A. Drummondi	Hinsdale Co., Colorado	Rollins 1506	7	14
A. Fendleri				
var. typica	Gunnison Co., Colorado	Rollins 2098	7	14?
var. typica	Costilla Co., Colorado	Rollins 1288	21	
var. spatifolia	Fremont Co., Colorado	Rollins 2069	7	14
var. spatifolia	Chaffee Co., Colorado	Rollins 2077	7	
var. spatifolia	San Juan Co., Colorado	Rollins 1511	14	
A. Gunnisoniana	Gunnison Co., Colorado	Rollins 2090	7	
A. hirsuta				
var. pycnocarpa	Windham Co., Connecticut	Weatherby and Rollins s. n.	16	

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[1] Jahrb. Wiss. Bot. **68**: 1–45 (1928).

[2] Annals Bot. **46**: 516 and 543 (1932).

[3] Am. Journ. Bot. **25**: 220 (1938).

Chromosome-Numbers in Arabis—(*Continued*)

Species	Place of Collection	Collector and Number	N	2N
var. pycnocarpa	Daggett Co., Utah	Rollins 2267	32	
var. pycnocarpa	Gunnison Co., Colorado	Rollins 1427	16	32
A. Holboellii				
var. retrofracta	Sublette Co., Wyoming	Ownbey 1008	7	
var. retrofracta	Albany Co., Wyoming	Rollins 1070	7	
var. retrofracta	Larimer Co., Colorado	Rollins and Chambers 2401	7	
var. retrofracta	Mesa Co., Colorado	Rollins 2188	7	
var. retrofracta	Uintah Co., Utah	Rollins 1765	14	
var. retrofracta	Humboldt Co., Calif.	Harris et al. 3417	7	14
var. pinetorum	Lake Co., Colorado	Rollins 1349	21	
var. pinetorum	Gunnison Co., Colorado	Rollins 1426	14	
A. laevigata	Litchfield Co., Connecticut	Weatherby s. n.	7	
A. lignifera	Uinta Co., Wyoming	Rollins 2308	7?	14
A. lignifera	Montrose Co., Colorado	Rollins 2129	7	
A. lyrata	Litchfield Co., Connecticut	Weatherby s. n.	8	
A. microphylla				
var. typica	Wallowa Co., Oregon	Constance 1274	7	
var. saximontana	Big Horn Co., Wyoming	Williams 3264	14	
A. perennans	Mesa Co., Colorado	Rollins 2128	7	14
A. repanda	Madera Co., California	Constance 2386	7	

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SYNOPSIS OF THE GENUS ARABIS L. IN WESTERN NORTH AMERICA

ARABIS L. Biennial or perennial herbs, often with a ligneous base, glabrous to sparsely or densely pubescent with simple, bifurcate, stellate or dendritic trichomes; caudex simple or branched; stems terete, leafy, simple or branched; basal leaves petiolate, entire, dentate or rarely somewhat dissected, persistent or caducous; cauline leaves sessile or rarely petiolate, often auricled, approximate to remote, entire or dentate; inflorescence racemose, ebracteate, greatly elongating as the flowers successively expand; flowers erect to reflexed at anthesis, tetradynymous; sepals erect, oblong to nearly ovate, uniform, or the outer pair infrequently saccate, bounded on the sides and apex by a narrow non-chlorophyllous margin; petals spatulate to oblong, less frequently narrowly obovate, white to deeply purple, rarely stramineous; filaments linear to narrowly subulate, entire, erect, straight or the single ones rarely curved upwards from their base; anthers oblong; nectar-glands in a continuous mold beneath all stamens to merely subtending the base of the single stamens; siliques linear, straight or curved, erect to reflexed, sessile or very rarely with a short gynophore, flattened parallel to partition, rarely semi-terete, two-valved; valves prominently one-nerved to completely nerveless in rare instances, sometimes minutely net-veined; style prominent or none; stigma entire to rarely somewhat bilobed; septum nerveless or with a variable central band of differentiated tissue; seeds numerous, pendulous, orbicular to nearly oblong, flattened or plump, winged or wingless, uniseriate to biseriate, funiculus free or nearly so, cotyledons accumbent.—L., Sp. Pl. **2:** 664 (1753); Gen. Pl., ed. 5, 298 (1754); DC., Syst. **2:** 213–244 (1821) and Prod. **1:** 142–149 (1824); Hooker, Fl. Bor.-Am. **1:** 41–43 (1829); Torrey & Gray, Fl. N. Am. **1:** 79–83 (1838); Gray, Gen. Illustr. **1:** 141, pl. 58 (1848); Watson in Gray, Syn. Fl. **1:** 159–167 (1895); Howell, Fl. Northw. Am. **1:** 42–46 (1897); Piper in Contrib. U. S. Nat. Herb. **11:** 291–295 (1906); Coulter & Nelson, New Man. Bot. Rky. Mts. 225–229 (1909); Wooton & Standley in Contrib. U. S. Nat. Herb. **19:** 279–280 (1915); Henry, Fl. So. Brit. Columb. 149–150 (1915); Rydberg, Fl. Rky. Mts. 356–363 (1918); Tidestrom in Contrib. U. S. Nat. Herb. **25:** 241–245 (1925); Jepson, Man. Fl. Pl. Calif. 427–433 (1925) and Fl. Calif. **2:** 59–73 (1936); Munz, Man. So. Calif. Bot. 202–205 (1935); Rollins in Res. Stud. State Coll. Wash. **4:** 1–52 (1936); O. E. Schulz in Engler, Pflanzenf. 2 Aufl., **17b:** 542 (1936); Hopkins in RHODORA **39:** 63–98, 106–148, 156–186 (1937). *Turritis* L., Sp. Pl. **2:** 666 (1753); Gen. Pl. ed. 5, 298 (1754); DC., Syst. **2:** 211–13 (1821) and Prod. **1:** 139–140 (1824); Hooker, Fl. Bor.-Am. **1:** 40–41 (1829); Torrey & Gray, Fl. N. Am. **1:** 78 (1838); Gray, Gen. Illustr. **1:** 143, pl. 59 (1848). LECTOTYPE SPECIES—*A. alpina*, L.

ARTIFICIAL KEY TO THE SPECIES

A. Seed-wing 1–3 mm. wide or, if slightly less, then cauline leaves petiolate; seeds (including wings) 2.5–5 mm. long; siliques 3–8 mm. wide (rarely slightly narrower)......B.

B. Cauline leaves petiolate, the lower dissected to the midrib; petiole not winged; basal leaves 10–15 cm. long; Texas..53. *A. petiolaris.*

B. Cauline leaves sessile, or if petiolate, then the petiole winged, entire or merely dentate; basal leaves less than 8 cm. long.....................................C.

C. Siliques and pedicels erect or ascending............D.

D. Lower cauline leaves petiolate; petiole winged; basal leaves oblanceolate to broadly spatulate, 1–3 cm. wide; petals equaling or only slightly exceeding sepals; Nevada and California ....45. *A. repanda.*

D. All cauline leaves sessile; basal leaves linear to oblanceolate, less than 8 mm. wide; petals definitely exceeding the petals..........................E.

E. Leaves and lower stems hoary with a minute pubescence; pedicels pubescent; California ....47. *A. dispar.*

E. Leaves and stems green, glabrous or pubescent, but never hoary; pedicels glabrous...............F.

F. Basal leaves linear, about 2 mm. wide, densely hirsute with very coarse trichomes, persistent and forming successive hemispherical rosettes on the elongated crown; California ....52. *A. pygmaea.*

F. Basal leaves oblanceolate to spatulate, 3–8 mm. wide, glabrous or pubescent with much finer trichomes than the above, deciduous, not forming successive rosettes on the crown; Nevada, California and Oregon................51. *A. platysperma.*

C. Siliques and pedicels reflexed (horizontal in *A. suffrutescens,* var. *horizontalis*)....................G.

G. Leaves and stems green, glabrous or pubescent below only; siliques attenuate at apex; seeds uniseriate; Idaho to California and Washington........50. *A. suffrutescens.*

G. Leaves and stems hoary with a minute pubescence; siliques obtuse at apex; seeds biseriate; California and Nevada............................46. *A. glaucovalvula.*

A. Seed-wing less than 1 mm. wide or seeds wingless; seeds (including wings) less than 2 mm. long; siliques usually less than 3 mm. wide, very rarely up to 3.5 mm. wide..H.

H. Basal leaves obovate to broadly oblanceolate, obtuse and rounded at apex, often forming a flat rosette at base of stems, usually rather thin, blade nearly as broad as long, glabrous or hirsute with simple or forked trichomes except in *A. crucisetosa, A. modesta* and var. *furcatipilis* of *A. glabra;* siliques erect or ascending; styles often evident; stems often hirsute with simple or forked trichomes near base; glandular tissue subtending single stamens only, or disrupted and poorly developed near paired stamens; outer sepals saccate except in *A. glabra*...I.

I. Seeds biseriate; siliques semi-terete; flowers creamy-yellow (rarely lilac); cauline leaves ample, ovate to ovate-lanceolate, usually glaucous; widely distributed from Quebec to California.........................1. *A. glabra.*

I. Seeds uniseriate; siliques flattened parallel to septum; flowers white to purple; cauline leaves much smaller except occasionally in *A. hirsuta,* obovate to oblong, rarely if ever glaucous..........................J.

J. Seeds definitely winged at least at the distal end; flowers purple to white........................K.

K. Plants completely glabrous...................L.

L. Basal leaves 3–8 cm. long, broadly oblanceolate, entire or rarely few-toothed; California to Oregon.................................12. *A. Davidsonii.*

L. Basal leaves less than 2.5 cm. long, ovate to spatulate, dentate to rarely entire..........M.

M. Flowers purple; petals truncate at apex; plants of California................6. *A. McDonaldiana.*

M. Flowers white; petals rounded at apex; plants of Washington and northern Oregon......8. *A. furcata.*

K. Plants pubescent at least on lower stems and basal leaves ....N.

N. Flowers purple, showy; petals 9–20 mm. long; pedicels pubescent.........................O.

O. Petals 4–8 mm. broad, rounded at apex or retuse; plants pubescent at least on lower stems and basal leaf-margins.............P.

P. Plants more than 2 dm. high; siliques acute, 3.5–6.5 cm. long; style slender or obsolete; southern Oregon and extreme northern California ....Q.

Q. Lower stems appressed-pubescent; basal leaves not ciliate; pubescence of uniform, small dendritic trichomes.............5. *A. modesta.*

Q. Lower stems hirsute; basal leaves ciliate, pubescence of large simple, forked or dendritic trichomes.

Caudex multicipitally branched; basal leaves 1–4 cm. long, hirsute and ciliate with large white simple or rarely forked trichomes; cauline leaves 5–15 mm. long..........7. *A. aculeolata.*

Caudex simple or rarely closely branched; basal leaves 3–8 cm. long, pubescent with large dendritic or forked trichomes with bulbous bases; cauline leaves 2–5 cm. long........4. *A. oregana.*

P. Plants less than 2 dm. high; siliques 2–4 cm. long, obtuse, usually with a stoutish style; south from Sonoma Co., California 3. *A. blepharophylla.*

O. Petals 2.5–3 mm. broad, usually truncate at apex; plants usually glabrous, but rarely with a few marginal trichomes on the basal leaves 6. *A. McDonaldiana.*

N. Flowers white, rarely pinkish; petals less than 11 mm. long; pedicels glabrous or very rarely sparsely hirsute in *A. hirsuta.*

Stems glabrous; pedicels divaricately ascending; siliques 2–4 cm. long; cauline leaves not auriculate; Oregon and Washington..8. *A. furcata.*

Stems hirsute at least below; pedicels erect, rarely divaricately ascending; siliques 3–6 cm. long; cauline leaves auriculate; widely distributed..............................2. *A. hirsuta.*

J. Seeds wingless; flowers white.....................R.

R. Basal leaves hirsute with large simple or rarely forked trichomes to glabrous; lower stems hirsute with spreading trichomes or glabrous.

Basal leaves entire; lower cauline leaves sessile; styles 1 mm. or more long; Montana to Utah and Washington....................9. *A. Nuttallii.*

Basal leaves lyrate-pinnatifid to dentate; lower cauline leaves usually petiolate; styles less than 1 mm. long or absent; Washington to Saskatchewan and Alaska..11. *A. lyrata,* var. *kamchatica.*

R. Basal leaves rather densely pubescent on both surfaces with dendritic trichomes, never ciliate; lower stems appressed-pubescent to glabrous; Idaho and Washington....................10. *A. crucisetosa.*

H. Basal leaves linear to linear-oblanceolate (if broader, then minutely pubescent or the siliques reflexed or both), acute or rarely obtuse, usually thick, rarely rounded at apex, ascending, not forming a flat rosette at base of stems; pubescence varied or absent; siliques erect to reflexed; glandular tissue continuous beneath all stamens; outer sepals non-saccate or only slightly so..S.

S. Leaves, stems and pedicels hoary with a very minute pubescence; mostly desert plants or plants from mountain ranges bordering the deserts............T.

T. Siliques erect or ascending to widely spreading; pedicels erect to spreading at right angles to rachis...U.

U. Styles less than 1 mm. long or the stigma sessile; basal leaves narrowly oblanceolate............V.

V. Seeds uniseriate, winged, flattened, 1.5–2.5 mm. broad.

Seed-wing over 0.5 mm. wide; siliques 2.5–3.5 mm. wide, divaricately ascending; California..................................47. *A. dispar.*

Seed-wing less than 0.5 mm. wide; siliques about 2 mm. wide, spreading at right angles; California....................42. *A. inyoensis.*

V. Seeds biseriate, essentially wingless, plump, about 1 mm. broad; Utah to California..........41. *A. Shockleyi.*

U. Styles 1–8 mm. long; basal leaves linear.

Styles 4–8 mm. long; seeds narrowly winged; siliques 1–2 cm. long; California............49. *A. Parishii.*

Styles 1–3 mm. long; seeds broadly winged; siliques 3–5 cm. long; California..........48. *A. Johnstonii.*

T. Siliques reflexed; pedicels strongly reflexed to pendulous..................................W.

W. Seeds biseriate; cauline leaves linear, not crowded, entire; Colorado to California ....43. *A. pulchra.*

W. Seeds uniseriate; cauline leaves oblong to broadly lanceolate, crowded, often subpinnatifid.

Siliques blunt at apex; style wanting; petals 7–10 mm. long; Idaho to California and Washington...........................38. *A. puberula.*

Siliques acuminate at apex; style about 1 mm. long; petals 10–14 mm. long; California and Oregon ....39. *A. subpinnatifida.*

S. Cauline leaves, stems and pedicels greenish, densely pubescent to glabrous, never hoary; basal leaves sometimes hoary-pubescent, but usually greenish, densely pubescent to glabrous....................X.

X. Mature fruiting pedicels erect to ascending, never diverging at right angles to rachis or descending; siliques erect, ascending or more rarely arcuate..Y.

Y. Basal leaves narrowly oblanceolate to spatulate or rarely almost linear, pubescent to glabrous, but not hirsute with large spreading simple or forked trichomes; lower cauline leaves variously pubescent or glabrous, but not hirsute, auriculate to non-auriculate ....Z.

Z. Lower fruiting pedicels 2–4 cm. long, glabrous; siliques arcuate or at least somewhat curved; seeds biseriate.

Lower stems densely hirsute; siliques nerved below, not coriaceous; lower cauline leaves pubescent on both surfaces; Arizona..25. *A. gracilipes.*

Lower stems glabrous to very sparsely pubescent with appressed trichomes; siliques nerveless, thick and coriaceous; lower cauline leaves glabrous above; Santa Cruz Island, California..................27. *A. Hoffmannii.*

Z. Lower fruiting pedicels less than 2 cm. long, pubescent or glabrous; siliques straight to arcuate, if arcuate, then the seeds uniseriate..a.

a. Basal leaves and lower cauline leaves densely pubescent with dendritic trichomes, gray, often pannose or appearing so; siliques straight to somewhat curved or arcuate; stems usually numerous from a much-branched caudex.........................b.

b. Basal leaves linear to linear-oblanceolate, usually less than 5 mm. broad; siliques straight except in *A. Koehleri* and *A. sparsiflora*............................c.

c. Petals less than 7 mm. long; stigmas mostly sessile; styles rarely up to 1 mm. long..........................d.

d. Basal leaves pannose, very finely pubescent; cauline leaves oblong to narrowly ovate, crowded near base; pedicels pubescent; lower stems finely pubescent..........................e.

e. Siliques about 1 mm. wide, erect, valves constricted between seeds; seeds wingless to very narrowly winged; Colorado.....................33. *A. Crandallii.*

e. Siliques 1.5–2 mm. wide, divaricately ascending, valves not constricted between seeds; seeds definitely winged.

Siliques acuminate at apex; style about 1 mm. long; cauline leaves non-auriculate; Nevada
32b. *A. Fernaldiana* var. *stylosa.*

Siliques blunt at apex; stigma sessile, cauline leaves auriculate; Nevada and California
18d. *A. Lemmoni* var. *depauperata.*

d. Basal leaves not pannose, though often appearing so to the naked eye; cauline leaves narrowly lanceolate, remote; pedicels glabrous; lower stems hirsute to glabrous; Wyoming to Nevada and Washington ....31. *A. microphylla.*

e. Petals 7–14 mm. long; styles about 1 mm. long or stigmas sessile ....f.

  f. Basal leaves linear, rather coarsely pubescent, not pannose, acute; siliques usually curved; caudex-branches elongated.

    Plants 3–9 dm. high; pedicels pubescent or glabrous; lower stems pubescent or rarely glabrous; caudex without numerous peg-like leaf-bases; widely distributed from the Rocky Mountains to California and Yukon ....26. *A. sparsiflora.*

    Plants mostly less than 3 dm. high; pedicels glabrous; lower stem glabrous or rarely sparsely pubescent; caudex covered with numerous peg-like leaf-bases; southern Oregon 30. *A. Koehleri.*

  f. Basal leaves linear-oblanceolate, minutely pubescent, pannose, obtuse; siliques straight; caudex-branches not elongated.

    Style absent, stigma sessile; pedicels and siliques divaricate; California ....42. *A. inyoensis.*

    Style about 1 mm. long; pedicels and siliques erect; Nevada ......32. *A. Fernaldiana.*

b. Basal leaves oblanceolate, often broadly so, 6–15 mm. wide; siliques somewhat curved ....g.

  g. Stems and pedicels hirsute with spreading trichomes; cauline leaves ovate to broadly oblong, mostly approximate; California and southern Oregon......28. *A. Breweri.*

  g. Stems and pedicels pubescent with minute appressed trichomes to glabrous; cauline leaves lanceolate, remote; Colorado....35. *A. Selbyi.*

a. Basal leaves pubescent to glabrous, greenish, never pannose; lower leaves and stems glabrous to sparsely pubescent; siliques straight; stems one to several or many; caudex usually simple except in *A. Lyallii* and *A. fruticosa* ....h.

  h. Siliques 1.5–3.5 mm. wide; seeds orbicular to oblong, 1–2 mm. broad; stems glabrous to appressed-pubescent below, never hirsute with spreading trichomes ....i.

    i. Seeds biseriate, oblong, winged on one side and the distal end; siliques and pedicels erect; siliques usually blunt; basal leaves strigose with malphigiaceous hairs or glabrous; flowers white, very rarely pinkish; widely distributed .....14. *A. Drummondi.*

i. Seeds uniseriate or rarely imperfectly biseriate, orbicular, winged all around; siliques and pedicels divaricately ascending to erect, siliques usually acute; basal leaves pubescent with three- to several-branched trichomes or glabrous; flowers pink to purple ....j.

j. Plants less than 3 dm. high; stems several to numerous from a branching caudex; siliques and pedicels erect to slightly divergent; widely distributed ......13. *A. Lyallii.*

j. Plants 3–9 dm. high; stems usually single, rarely two or three from a simple caudex; siliques and pedicels divaricately ascending to more widely spreading. .k.

k. Siliques 1.5–2.5 mm. wide, margin straight; seeds 1–1.5 mm. broad.

Basal leaves sparsely pubescent with minute dendritic trichomes; cauline leaves glaucous, ovate; siliques glaucous, nerved only at very base or nerveless; Wyoming (rare) ....16. *A. fructicosa.*

Basal leaves sparsely pubescent with appressed several-branched, rather coarse trichomes or glabrous; siliques not glaucous, nerved at least to the middle; caudex simple; widely distributed. ....15. *A. divaricarpa.*

k. Siliques 2.5–3.5 mm. wide, margin undulate; seeds 2–2.5 mm. broad; California ....17. *A. rigidissima.*

h. Siliques less than 1.5 mm. wide; seeds orbicular, about 1 mm. broad; stems sparsely hirsute at base; Wyoming to California and British Columbia ....31. *A. microphylla.*

Y. Basal leaves narrowly linear, densely hirsute with large simple or forked trichomes; lower cauline leaves hirsute, linear, non-auriculate; Idaho to Oregon and Washington ....29. *A. Cusickii.*

X. Mature fruiting pedicels diverging at right angles to strictly reflexed; siliques straight to arcuate, diverging at right angles to rachis to strictly reflexed ....l.

l. Basal leaves definitely ciliate with large acerose simple or forked trichomes, rarely glabrous, blades hirsute with simple or forked hairs to glabrous; pedicels glabrous, gently curving downward except in *A. rectissima* where they are geniculately reflexed ....m.

m. Siliques pendulous on gently curving pedicels, never appressed to rachis; basal leaves linear to broadly oblanceolate ....n.

n. Plants 2.5–6 dm. high; stems few to several, fairly robust; seeds biseriate; lower cauline leaves crowded to slightly overlapping or remote; pedicels 1–2 cm. long.

Siliques 2–4 cm. long; cauline leaves small, mostly remote; basal leaves hirsute with simple trichomes to glabrous; Utah and Nevada . . . . 21. *A. pendulina.*

Siliques 4–6 cm. long; cauline leaves fairly ample, lower imbricated; basal leaves hirsute on the blade-surfaces with forked trichomes, ciliate with simple or forked trichomes; Wyoming to Texas, Mexico and Nevada . . . . 23. *A. Fendleri.*

n. Plants caespitose, 1–3 dm. high, usually less than 2 dm. high; stems slender; seeds uniseriate except in *A. pendulina;* cauline leaves remote; pedicels 3–10 mm. long . . . . o.

o. Seeds biseriate; siliques blunt, 2–3 mm. wide . . . . 21. *A. pendulina.*

o. Seeds uniseriate; siliques slightly tapering at apex; 1.5–2 mm. wide.

Siliques definitely pendulous, acute to obtuse; at least some of the basal leaves densely hirsute; Wyoming, Colorado and Utah . . . . 20. *A. demissa.*

Siliques almost oblique to widely pendulous, acuminate; basal leaves glabrous, thin; Colorado (rare) . . . . 19. *A. oxylobula.*

m. Siliques strictly reflexed, appressed to rachis; pedicels geniculate; basal leaves oblanceolate to slightly broader; California and Oregon 22. *A. rectissima.*

l. Basal leaves densely pubescent with fine to coarse dendritic trichomes, blades always pubescent, never merely hirsute with simple or forked hairs; pedicels pubescent to glabrous, spreading at right angles to strictly reflexed . . . . p.

p. Cauline leaves sessile, never petiolate; filaments of single stamens straight, erect; petals at least one-third longer than the sepals . . . . . q.

q. Seeds uniseriate; cauline leaves lanceolate to oblong or ovate, rarely linear; petals less than 12 mm. long, their limbs not spreading; siliques glabrous except occasionally in *A. Holboellii,* var. *retrofracta* . . . . r.

r. Basal leaves spatulate to oblanceolate, never linear; seed-wing less than 0.3 mm. wide; cauline leaves not pannose; stems rigid; siliques widely spreading to strictly reflexed . . . . s.

s. Pedicels 2–4 (–6) mm. long; siliques spreading at right angles to rachis; cauline leaves ovate, mostly glabrous; widely distributed . . . . 18. *A. Lemmoni.*

s. Pedicels 6–20 mm. long; siliques spreading to reflexed; cauline leaves oblong to lanceolate, mostly pubescent . . . . t.

t. Mature fruiting pedicels spreading at right angles to rachis, straight or arched downward, not strongly descending or strictly reflexed; siliques straight and spreading at right angles or arcuate. . u.

u. Plants 1–2 (–3) dm. high, caespitose; stems numerous, filiform; cauline leaves few, small and remote.

Cauline leaves linear-lanceolate, 1–2 cm. long; pedicels glabrous; stems hirsute below, usually branched; Wyoming to California and British Columbia.................31. *A. microphylla.*

Cauline leaves oblong, 5–8 mm. long; pedicels pubescent; stems simple, densely pubescent, but not hirsute with spreading trichomes; Colorado ....34. *A. Gunnisoniana.*

u. Plants 3–9 dm. high, rarely caespitose; stems one to several, fairly stout; cauline leaves usually numerous, crowded and overlapping near base of stem, except in *A. perennans* ..v.

v. Basal leaves entire, finely and densely pubescent with minute dendritic trichomes; stems densely appressed-pubescent at least below; pedicels sparsely pubescent to glabrous; stems several to few.

Pedicels and siliques rigidly spreading at right angles to rachis, straight; seed-wing 0.2–0.3 mm. wide; California ....42. *A. inyoensis.*

Pedicels and siliques curved downward; siliques usually curved; seed-wing very narrow (less than 0.2 mm. wide); Wyoming to Arizona and Nevada ....36. *A. lignifera.*

v. At least the outer basal leaves dentate, densely pubescent with coarse dendritic trichomes; stems mostly hirsute with spreading hairs below, rarely appressed-pubescent; pedicels often hirsute; stems one to several or many.

Outer basal leaves broadly oblanceolate, obtuse; pedicels slender, 1–2 cm. long, glabrous; petals 6–9 mm. long, 1.5–2.5 mm. wide; Colorado to Mexico and California ....24. *A. perennans.*

Outer basal leaves narrowly oblanceolate, acute; pedicels stout, 5–12 mm. long, hirsute or appressed-pubescent in var. *californica;* petals 8–12 mm. long, 2–4 mm. wide; widely distributed ....26. *A. sparsiflora.*

t. Mature fruiting pedicels definitely descending to strictly reflexed, straight, not widely spreading with tips descending; siliques mostly straight, pendulous to strictly appressed against the rachis ....w.

w. Pedicels strictly reflexed, appressed to the rachis; widely distributed. .37. *A. Holboellii.*
w. Pedicels strongly descending, but not appressed to the rachis ....x.
x. Stems hirsute with spreading trichomes below; siliques straight or nearly so ....37. *A. Holboellii.*
x. Stems finely appressed-pubescent below; siliques often slightly curved and usually widely pendulous; Wyoming to Arizona and Nevada. .36. *A. lignifera.*
r. Basal leaves linear, minutely pubescent, usually pannose; seed-wing about 0.5 mm. wide; cauline leaves pannose; stems weak; siliques pendulous on widely spreading slender pedicels; Wyoming to Nevada and Oregon ....40. *A. cobrensis.*
q. Seeds definitely biseriate; cauline leaves linear; petals 8–20 mm. long, usually showy, petal-limb spreading at right angles; siliques densely pubescent except in var. *gracilis;* Colorado to California and Mexico......43. *A. pulchra.*
p. Cauline leaves petiolate; filaments of single stamens arising at right angles to receptacle and curved upward; petals barely exceeding the sepals; Arizona ....44. *A. tricornuta.*

1. A. GLABRA (L.) Bernhardi. Biennial or rarely perennial; stems one or few from a tap-root, simple or rarely branched above, stout, glabrous and glaucous above, pubescent (usually hirsute) below, 4–12 dm. high; basal leaves broadly oblanceolate to oblong or spatulate, petiolate, repand, dentate or sometimes rather deeply divided, rarely entire, coarsely pubescent with forked or dendritic trichomes, rarely almost glabrous, 6–15 cm. long, 1–3 cm. wide, petiole usually hirsute; cauline leaves lanceolate to ovate, entire or the lower toothed, sessile, auricled, sagittate, glabrous or the lower sparsely pubescent, 4–15 cm. long, 1–4 cm. wide; sepals oblong, non-saccate, obtuse, yellowish to rarely purplish, 3–5 mm. long; petals linear to narrowly spatulate, slender-clawed, yellowish-white or very rarely purplish, 5–7 mm. long; glandular tissue subtending single stamens, absent or nearly obsolete near paired stamens; siliques strictly erect, semi-terete to slightly more flattened, glabrous, 4–10 cm. long, slightly more than 1 mm. wide, valves nerved to the middle or often to the tip; style short and stout; stigma expanded; seeds oblong to nearly orbicular, wingless to very narrowly winged, biseriate or nearly so.

Pubescence of the stem simple or rarely forked, spreading. .1a. Var. *typica.*
Pubescence of the stem several-branched, appressed....1b. Var. *furcatipilis.*

1a. Var. TYPICA Hopkins in RHODORA **39:** 106 (1937). *A. glabra* (L.) Bernh., Syst. Verz. Erf. 195 (1800). *Turritis glabra*

L., Sp. Pl. **2:** 666 (1753). *Arabis perfoliata* Lam., Dict. **1:** 219 (1793). *Turritis macrocarpa* Nuttall in T. & G., Fl. N. Am. **1:** 78 (1838). *Arabis macrocarpa* (Nutt.) Torrey in Bot. Mex. Boundary pt. 1: 32 (1858). *Turritis glabra,* var. *lilacina* O. E. Schulz in Fedde, Repert. Sp. Nov. **33:** 191 (1933).—Quebec to North Carolina, California and British Columbia. Only the leading synonyms have been given above. For full synonymy, references, and citations of specimens see Hopkins, l. c.

1b. Var. FURCATIPILIS Hopkins. Stems pubescent below with appressed, several-branched trichomes. Pubescence smaller than in var. *typica.*—RHODORA **39:** 109 (1937).—Utah and California. UTAH: Logan City Camp, Logan Canyon, Cache Co., *Maguire 3437* (G, TYPE). CALIFORNIA: without locality, *T. Bridges 15* (G); Santa Lucia Mts., Monterey Co., March, 1898, *Plaskett 53* (G).

A. glabra is abundant and widely distributed in the mountains of our area where it is usually found in habitats ranging from moist shady places to open dry disturbed soils. The total distribution is very wide in temperate Asia and Europe as well as in North America. This species is often removed from *Arabis* and placed in the genus *Turritis,* but the characters used to make the separation are not convincing. The distinctive characters supposedly include yellowish petals as opposed to white or purple ones, semi-terete instead of definitely flattened siliques and biseriate instead of uniseriate seeds. As shown above, the seed-position in the silique may be untenable even as a species-criterion in *Arabis,* therefore it is of even less value as a generic character. Furthermore, a number of undoubted species of *Arabis* have biseriate seeds. The siliques of *A. glabra* are only semi-terete and in many cases they are flattened as much as those of *A. hirsuta.* As for petal-color, *A. glabra* does not have exclusively yellowish petals. Sometimes the petals are pink or even purplish. Other minor characters such as the angular nature of the silique or the complete nervation of the valves are sometimes pointed to as being distinctive, but these are variable in *A. glabra* and cannot be satisfactorily used to bolster generic segregation.

Two varieties of *A. glabra* have been distinguished in America. O. E. Schulz in 1933 described *Turritis glabra,* var. *lilacina,*[1] basing it upon the lilac color of the petals and sepal-margins.

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[1] Fedde, Repert. Sp. Nov. **33:** 191 (1933).

An isotype of this variety does not show the characters described by Schulz, but specimens from widely separated stations (Wyoming, *Rollins no. 991;* Idaho, *Rollins & Constance no. 1109* and Utah, *Garrett no. 2236*) have purplish to lilac-colored buds and newly expanded petals. The supposedly distinctive color fades to the usual straw-yellow as the flower fully expands. I do not consider plants with such dubious ephemeral characters to be worthy of any nomenclatorial recognition. In the case of Hopkins's var. *furcatipilis*,[1] a more fundamental character, that of pubescence-type, is used as a distinguishing character. The distribution of this variety, including as it does only isolated stations in northeastern Utah and western California, is peculiar. Perhaps the variety is not a natural one, but until more information is available on its distribution this cannot be determined.

2. A. HIRSUTA (L.) Scop. Biennial or perennial; stems erect, one to several from a simple or branching caudex, simple or branched above, hirsute with coarse, spreading, simple or forked trichomes (strigose with appressed malphigiaceous trichomes in var. *adpressipilis*), often glabrous above, 2–7 dm. high; basal leaves oblong to oblanceolate or broadly spatulate, short-petioled, obtuse to rarely acutish, entire, dentate or repand, hirsute on both surfaces with coarse simple or forked trichomes or rarely almost glabrous, 2–8 cm. long, 1–3 cm. wide; cauline leaves lanceolate to oblanceolate or nearly spatulate, acute or obtuse, sessile, auriculate, entire to coarsely dentate, hirsute on both surfaces or the upper glabrous, 1–5 (–7) cm. long, 0.5–2.5 cm. wide, approximate to remote; pedicels erect to divaricately ascending, glabrous or rarely sparsely hirsute, 0.5–1.5 cm. long; sepals oblong, glabrous or rarely with a few trichomes, 2.5–4.5 mm. long, about 1 mm. wide; petals white to rarely pinkish, oblong to spatulate, 3–9 mm. long; siliques erect, strict to divaricately ascending, glabrous, nerved below or nearly the entire length, 3–6 cm. long, 1–2 mm. wide; style 0.5–1 mm. long, stigma entire to slightly divided; seeds brown to blackish, suborbicular to nearly rectangular, prominently winged on the distal end to narrowly winged or wingless, 1–1.5 mm. long, about 1 mm. wide, uniseriate, cotyledons accumbent. The above description was drawn from American material.

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[1] RHODORA **39**: 109 (1937).

KEY TO THE AMERICAN VARIETIES OF A. HIRSUTA

a. Flowers small; petals 3–5 mm. long, white to yellowish-white; cauline leaves approximate to subremote, siliques strictly erect; outer sepals moderately saccate........b.
  b. Stem-pubescence spreading, mostly simple.......2a. Var. *pycnocarpa*.
  b. Stem-pubescence appressed, mostly malphigiaceous 2b. Var. *adpressipilis*.
a. Flowers larger; petals 5–9 mm. long, white to pinkish; cauline leaves mostly remote; siliques often somewhat divergent; outer sepals markedly saccate............c.
  c. Siliques about 1 mm. wide; stigma nearly entire; cauline leaves usually entire; upper stem glabrous; inland in the mountains from California to British Columbia..2c. Var. *glabrata*.
  c. Siliques 1.5–2 mm. wide; stigma noticeably bifid; cauline leaves usually dentate; upper stem hirsute; chiefly near the Pacific Coast-line from Alaska to Oregon...................................2d. Var. *Eschscholtziana*.

2a. Var. **pycnocarpa** (Hopkins), comb. nov. Cauline leaves approximate to subremote; stems hirsute with simple or forked trichomes; siliques strictly erect, 3–5 cm. long; seeds winged on the sides and distal end.—*A. pycnocarpa* Hopkins in RHODORA **39:** 112 (1937); Deam, Fl. Indiana 505 (1940). *Turritis ovata* Pursh, Fl. Am. Sept. **2:** 438 (1816)? *T. oblongata* Raf. in Am. Mo. Mag. **2:** 44 (1817)? *Arabis* "(turritis ovata)" (Pursh) Poir. in Lam. Encycl. Suppl. **5:** 557 (1817)? *A. sagittata*, γ *ovata* (Pursh) DC., Prod. **1:** 144 (1824)? *A. hirsuta*, γ *ovata* (Pursh) T. & G., Fl. N. Am. **1:** 80 (1838)? *A. hirsuta* sensu Hooker, Fl. Bor.-Am. **1:** 42 (1829) in part; T. & G., Fl. N. Am. **1:** 80 (1838); Gray, Man. 36 (1848); Watson in Gray, Syn. Fl. N. Am. **1:** 162 (1895) in part; Britton & Brown, Ill. Fl. **2:** 149 (1897); Small, Fl. Se. U. S. 484 (1903); Piper in Contrib. U. S. Nat. Herb. **11:** 293 (1906) in part; Robinson & Fernald in Gray, Man. ed. 7, 438 (1908); Coulter & Nelson, New Man. Bot. Rky. Mts. 227 (1909); Rollins in Res. Stud. State Coll. Wash. **4:** 14 (1936) in part. *A. ovata* (Pursh) Poir. sensu Rydb., Fl. Colo. 165 (1906); Fl. Rky. Mts. 359 (1918) in part; Fl. Pr. Pl. N. Am. 381 (1932); Wooton & Standley in Contrib. U. S. Nat. Herb. **19:** 280 (1915); Tidestrom in Contrib. U. S. Nat. Herb. **25:** 244 (1925); Small, Man. Se. Flora 571 (1933), wrongly attributed to Michx. *A. hirsuta*, f. *banffica* Tuzson in Bericht Frei. Ver. Syst. Bot. for 1919: 41 (1921). *A. hirsuta*, f. *constrictoides* Tuzson, ibid. *A. hirsuta*, f. *cordata* sensu Tuzson, ibid. *A. hirsuta*, f. *crepidifolia* Tuzson, ibid. *A. hirsuta*, f. *gracilis* Tuzson, ibid., p. 42. *A. hirsuta*, f. *iowensis* Tuzson, ibid. *A. hirsuta*, f. *laevis* Tuzson, ibid. p. 43. *A. hirsuta*, f. *novomexicana* Tuzson, ibid. *A. hirsuta*, f. *sagittata* sensu Tuzson, ibid. *A. pycnocarpa*, var. *reducta* Hopkins in RHODORA **39:** 117 (1937), based upon a pathological monstrosity.—Widespread from Quebec to Missouri, Arizona, British Columbia and Yukon.

A detailed discussion of leading characters, geographical distribution, and citations of specimens is given by Hopkins, l. c. under *A. pycnocarpa*, var. *typica* and need not be repeated in the present paper.

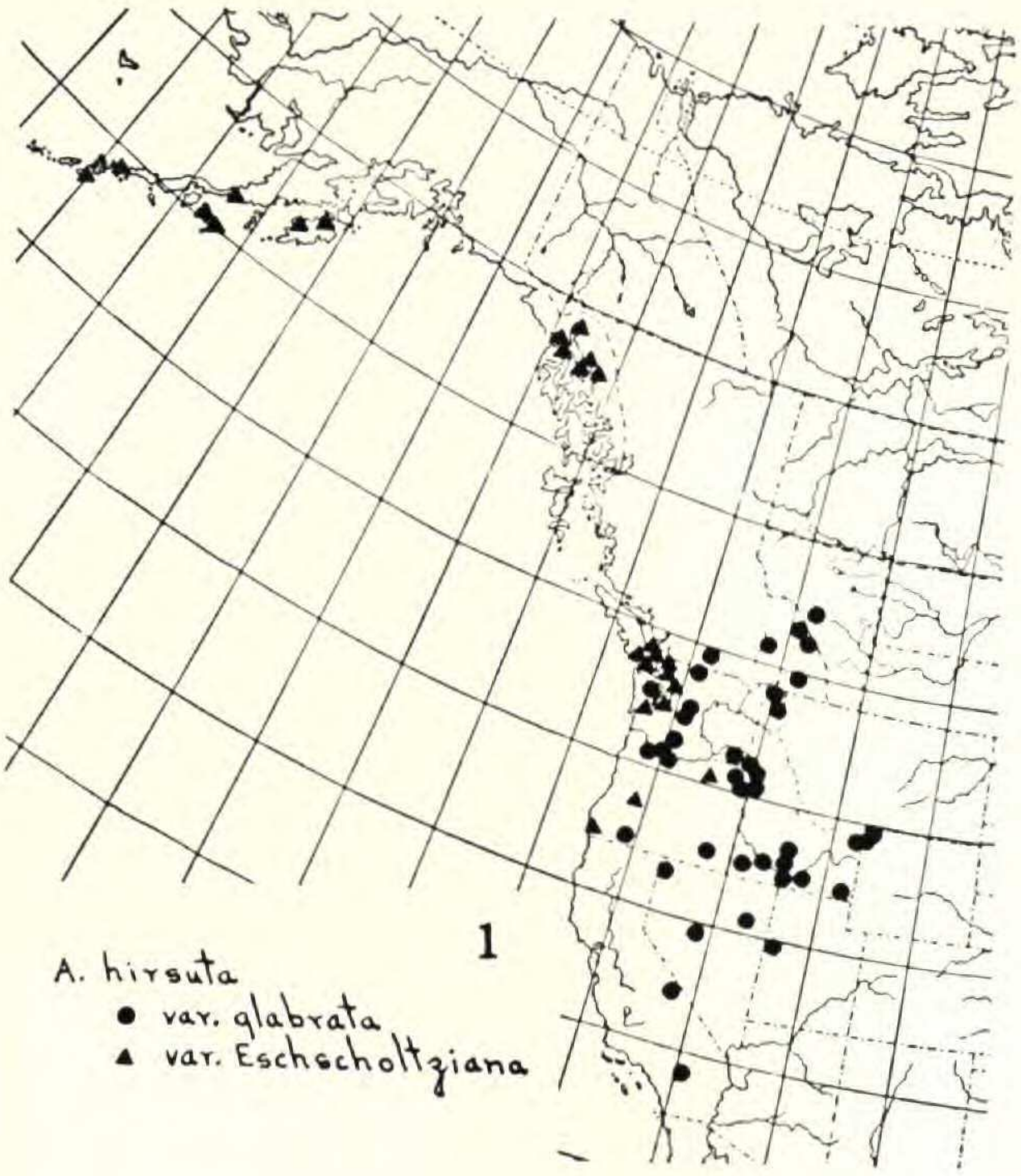
2b. Var. **adpressipilis** (Hopkins), comb. nov. *A. pycnocarpa* Hopkins, var. *adpressipilis* Hopkins in RHODORA **39:** 117 (1937); Deam, Fl. Indiana 506 (1940).

This variety is outside the area included in the present study, but its status has been verified, hence it is transferred to its proper place under *A. hirsuta.* A map showing the distribution of var. *adpressipilis* in the central United States may be seen in Hopkins paper cited above.

2c. Var. GLABRATA T. & G. Stems hirsute below, glabrous above; basal leaves obovate to oblanceolate, entire or rarely few-toothed, obtuse, sparsely hirsute to nearly glabrous, 3–7 cm. long, 1–2.5 cm. wide; cauline leaves obovate to oblong, rarely ovate, entire to rarely few-toothed; pedicels usually divaricately ascending; petals white, spatulate, 5–9 mm. long; siliques erect to slightly divaricate, usually not appressed, about 1 mm. wide.—*A. hirsuta, β glabrata* T. & G., Fl. N. Am. **1:** 80 (1838), not *A. hirsuta,* var. *glabrata* Döll (1862). *A. rupestris* Nuttall in T. & G., op. cit. p. 81; Rydberg, Fl. Rky. Mts. 359 (1917) in part; Tidestrom in Contrib. U. S. Nat. Herb. **25:** 244 (1925) in part. *Turritis spathulata* Nuttall in T. & G., op. cit. p. 78. *Arabis hirsuta* sensu Watson in Gray, Syn. Fl. N. Am. **1:** 162 (1895) in part; Howell, Fl. Northw. Am. **1:** 42 (1897) in part; Piper in Contrib. U. S. Nat. Herb. **11:** 293 (1906) in part; Coulter & Nelson, New Man. Bot. Rky. Mts. 227 (1909) in part; Jepson, Man. Fl. Pl. Calif. 428 (1925) and Fl. Calif. **2:** 61 (1936); Munz, Man. So. Calif. Bot. 204 (1935); Rollins in Res. Stud. State Coll. Wash. **4:** 14 (1936) in part. *A. hirsuta,* f. *americana* Tuzson in Bericht. Frei. Ver. Syst. Bot. for 1919, 41 (1921). *A. hirsuta,* f. *integra* Tuzson, ibid. p. 42. *A. pycnocarpa* Hopkins, var. *glabrata* (T. & G.) Hopkins in RHODORA **39:** 116 (1937) in part.—Alberta and British Columbia to Wyoming, Utah and California. MAP 1. ALBERTA: Kootenai Plains, north branch Saskatchewan River, June, 1908, *Brown 951* (G); June, 1908, *Brown 940* (G). WYOMING: Silver Gate, Yellowstone Nat. Park, June, 1885, *Tweedy 556* (US). IDAHO: near Hatwai Cr., Nez Perce Co., April, 1892, *Sandberg et al. 41* (G, isotype of *A. hirsuta,* f. *americana*); near Pollock, Idaho Co., May, 1937, *Constance 1856* (R); Silver City, Owyhee Co., June, 1911, *Macbride 991* (Cl, G, RM); near St. Anthony, June, 1919, *Quayle 58* (Cl, RM); Preston, May, 1909, *M. P. Henderson 48* (RM);

Hope, May, 1914, *Dunkle 412* (RM); Twin Falls-Shoshone Falls, July, 1911, *Nelson & Macbride 1352* (RM). UTAH: Deep Creek Mts., June, 1933, *Maguire & Becraft 2627* (R, RM, UAC); Troutcreek, Juab Co., June, 1933, *Maguire & Becraft 2628a* (G, RM, UAC). NEVADA: Lamoille Canyon, Ruby Mts., Elko Co., July, 1938, *Rollins & Chambers 2564* (G, R); about 10 miles south of Austin, Lander Co., June, 1937, *Goodner & Henning 117* (NA, R); 2 miles west of Uya, Washoe Co., May, 1939, *Train 2834* (NA, R). CALIFORNIA: Cottonwood Creek, White Mts., Mono Co., July, 1891, *Coville & Funston 1807* (G, US); Santa Ana River, San Bernardino Mts., Aug., 1922, *Munz 6324* (G, RM); July, 1926, *Munz 10797* (G); Bear Valley, San Bernardino Mts., June, 1922, *Munz 5728* (RM); Mill Creek Falls, San Bernardino Mts., June, 1901, *S. B. Parish 5069* (G). OREGON: near Cornucopia, Baker Co., July, 1936, *Thompson 13313* (G); Multnomah Falls Trail, Multnomah Co., May, 1940, *Beetle & Constance 2623* (R); Willamette River, *Nuttall s.n.* (G, isotype of *A. rupestris*); Elk Rock, June, 1917, *J. C. Nelson 1269* (G); Ashland-Klamath Falls, July, 1920, *Peck 9228* (G, NY); Ice Lake Trail, Wallowa Mts., June, 1936, *Eastwood & Howell 3310* (R); Steens Mts., July, 1896, *Leiberg 2469* (US). WASHINGTON: Winchester Mt., Whatcom Co., July, 1937, *Muencher 7879* (G); upper valley of Nisqually Glacier, Mount Rainier, June, 1894, *Allen 313a* (G); White River, Mt. Rainier, June, 1937, *G. N. Jones 9957* (G); Swauk River, Kittitas Co., 1913, *Sharples 87, 88 & 93* (G); Waitsburg, May, 1897, *R. M. Horner s.n.* (G); Cape Horn, Skamania Co., Aug., 1894, *Suksdorf 2355* (G); Constance Ridge, Olympic Mts., May, 1931, *Thompson 6560* (G). BRITISH COLUMBIA: Avalanche Patti, June, 1904, *Shaw 37* (G, isotype of *A. hirsuta*, f. *integra*); Emerald Lake, June, 1931, *Pease 22383* (G); Ainsworth near Kootanie Lake, July, 1890, *J. Macoun s.n.* (G); Glacier, June, 1906, *Brown 291* (G); Lower Frazer River, 1859, *Lyall s.n.* (G); near Lake Bootahnie, Marble Mts., June, 1938, *J. W. & E. Thompson 134* (G).

2d. Var. **Eschscholtziana** (Andrz.), comb. nov. Stems hirsute from base to the inflorescence with spreading simple or forked trichomes; basal leaves obovate to oblanceolate, repand to coarsely dentate, rarely entire, pubescent on both surfaces with coarse trichomes, 3–8 cm. long, 1.5–3 cm. wide; cauline leaves ovate to oblong, auriculate, acute or rarely obtuse, dentate, 1.5–5 (–7) cm. long, pubescent; petals white to pinkish, 5–10 mm. long; mature siliques erect to slightly spreading, 1.5–2.5 mm. wide; stigma usually noticeably bifid.—*A. Eschscholtziana* Andrz. in Ledeb., Fl. Alt. **3:** 25 (1831). *A. hirsuta* sensu Cham. & Schlecht. in Linnaea **1:** 15 (1826); Hooker, Fl. Bor.-Am. **1:** 42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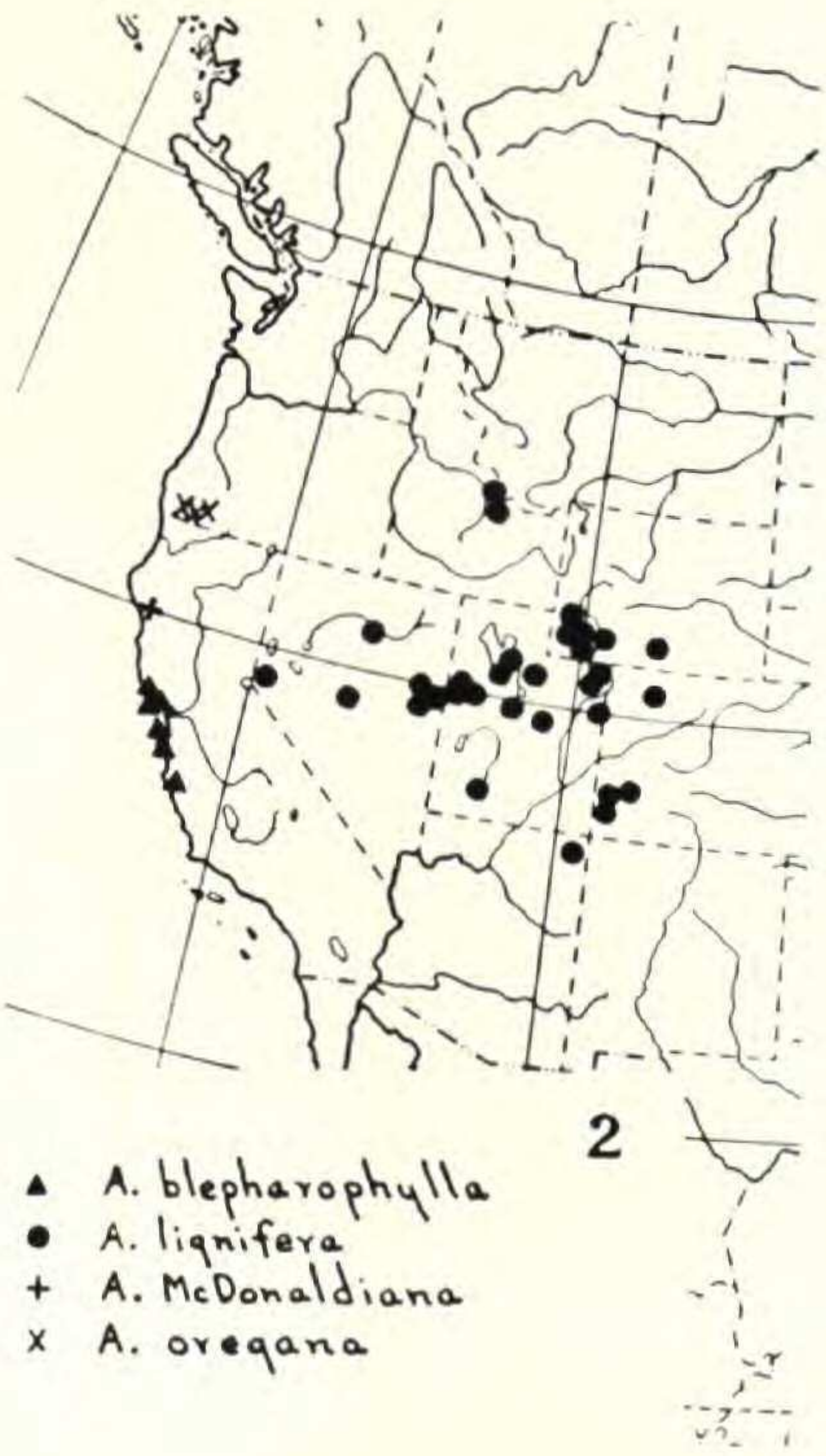
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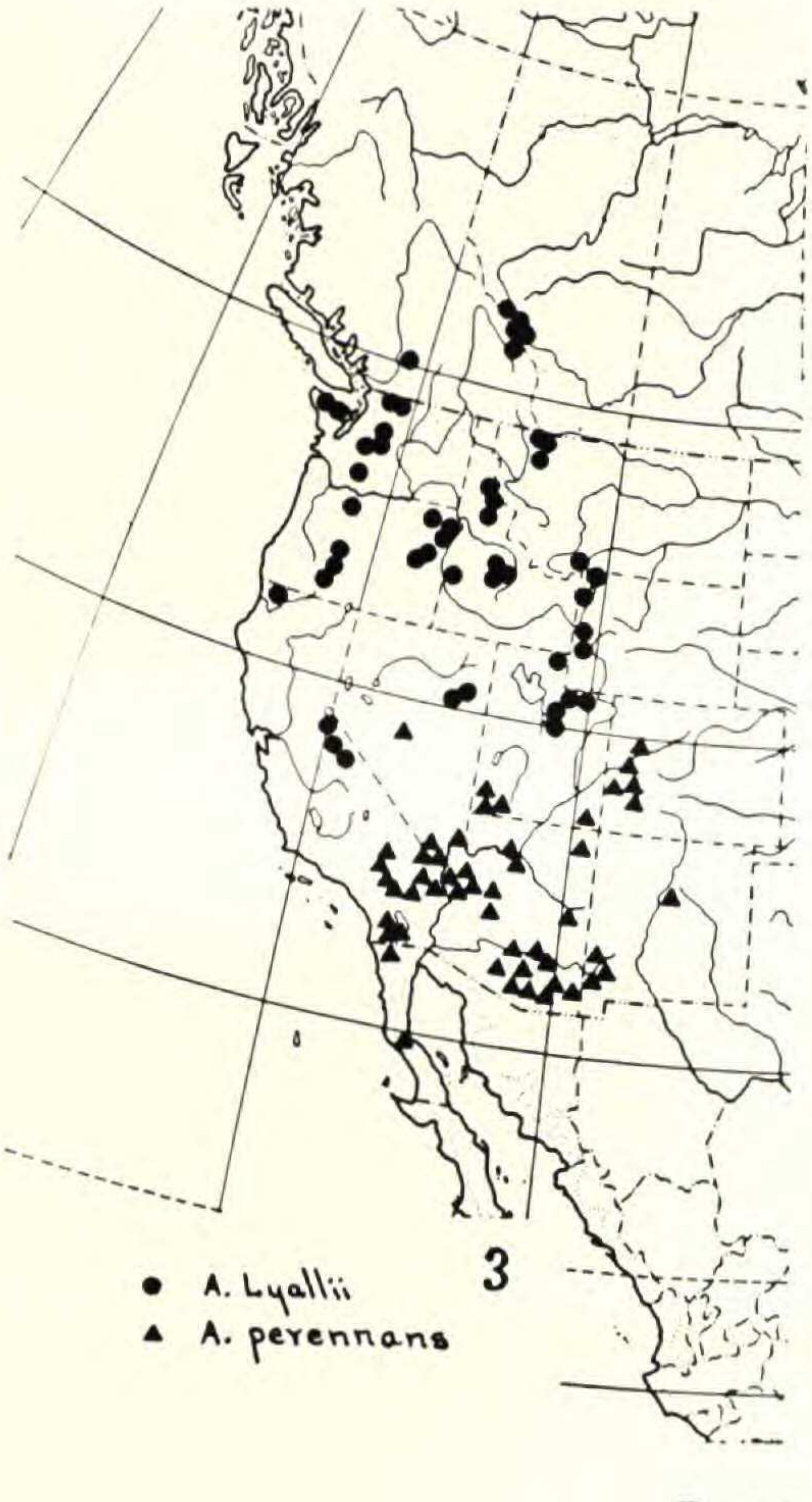
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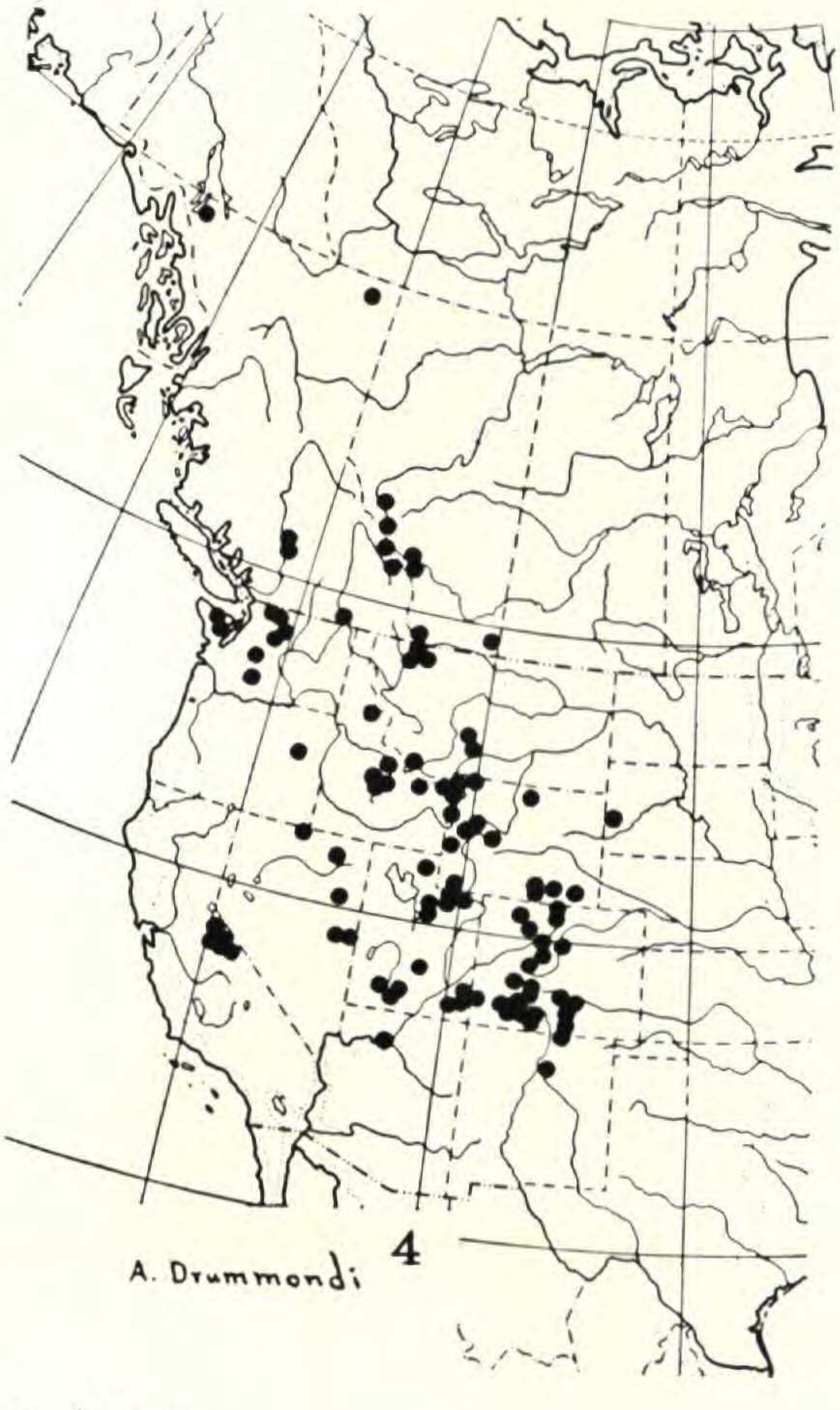
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Rollins on Arabis

(1829) in part; Ledeb., Fl. Ross. **3:** 118 (1842); Howell, Fl. Northw. Am. **1:** 42 (1897) in part; Piper in Contrib. U. S. Nat. Herb. **11:** 293 (1906) in part; Piper & Beattie, Fl. Northw. Coast 170 (1915) in part; Henry, Fl. So. Brit. Columb. 150 (1918) in part; Rollins in Res. Stud. State Coll. Wash. **4:** 14 (1936) in part. *A. hirsuta,* f. *Eschscholtziana* (Andrz.) Tuzson in Bericht. Frei. Ver. Syst. Bot. for 1919. 42 (1921). *A. hirsuta,* f. *grandiflora* Tuzson, ibid. *A. hirsuta,* f. *Krausei* Tuzson, ibid. p. 43. *A. hirsuta,* f. *lilacina* Tuzson, ibid. *A. hirsuta,* f. *subsetosa* Tuzson, ibid. p. 44. *A. Stelleri,* var. *Eschscholtziana* (Andrz.) Busch, Fl. Sib. & Orient. Ext. **4:** fam. 25. 438 (1926). *A. rupestris* sensu Hultén, Fl. Aleut. Is. 203 (1937).—Oregon to Alaska. MAP 1. OREGON: without locality, 1871, *E. Hall 33* (G); Harbor, Curry Co., June, 1919, *Peck 8737* (G, M); Kamela, Union Co., July, 1915, *Peck 2715* (G); Pauline Lake, July, 1894, *Leiberg 580* (G). WASHINGTON: near Fairhaven, Whatcom Co., July, 1890, *Suksdorf 1907* (G, R); Brown Island, near Friday Harbor, May, 1936, *Blanchard 29* (R, UC); near Dewatto, Kitsap Co., May, 1936, *Eicher 78* (G, R, WSC); Colonial Bob Mt., Grays Harbor Co., July, 1934, *Hodgdon & Rossbach 1 & 2* (G); mouth of Skagit River, Skagit Co., May, 1927, *Lucile Roush s.n.* (R); Semiahmoo Bay, 1858, *Lyall* (G). BRITISH COLUMBIA: Vancouver Island: San Juan Harbor, Aug., 1907, *Rosendahl 2061* (G); District of Renfrew, 1901, *Rosendahl & Brand 12* (G, RM); Cameron Lake, May, 1917, *W. R. Carter s.n.* (G); Manoose Bay, May, 1916, *W. R. Carter s.n.* (G). ALASKA: Taku Harbor, June, 1899, *Coville & Kearney 485* (G); near Skagway, June, 1906, *G. C. Deane, s.n.* (G); mouth of Yes Bay, *T. Howell 1608* (NY); Khantaak Island near Yakutat Bay, June, 1892, *Funston 15* (G); Admiralty Island, June, 1915, *Walker 723* (G); near Karluk, Kodiak Is., June, 1903, *Rutter 28* (G); Larson Bay, Kodiak Is., 1933, *Geist s.n.* (L); Olga Bay, Kodiak Is., June, 1938, *E. H. & H. B. Looff 647 & 648* (G, R); Dutch Harbor, Unalaska, 1907, *Van Dyke 12 & 113* (G), *Hultén 7651 & 5500* (L); Shumagin Islands, Popoff Is., June, 1892, *Harrington s.n.* (G), *Hultén 7708* (L); Chiachi Islands, June, 1874, *Dall s.n.* (G).

The studies of Tuzson[1] on the geographical distribution of *A. hirsuta* significantly show that the species with its multiplicity of forms extends interruptedly around the globe in the northern hemisphere. He gives the limits of occurrence as 38° to 65° north latitude, but the southern limit must be modified in North America to 35°, since the species has been found at about that latitude in Arizona and New Mexico. In all, according to Tuzson, over 25 species with numerous varieties have been described which really belong in *A. hirsuta.* Accordingly he has relegated many previously described variants to the rank of form and described a number of new forms, particularly from North America. Authentic material of twelve of the sixteen forms attributed to this continent has been studied, with the conclusion that too little material was taken into account when these forms were erected. Tuzson did not set up natural entities, consequently his names have been placed in synonymy under the three varieties of *A. hirsuta* in which they seem to belong.

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[1] Bericht. Frei. Ver. Syst. Bot. for 1919.

In treating *A. hirsuta* for North America, it appears that phylogeny is best served by the maintenance of the principal natural entities as varieties rather than as species, since treating them as species tends to obscure the very close relationship which exists between them. Actually there is a certain amount of intergrading between these entities and if they could not be correlated with geographic areas, their continuation even as varieties might be seriously challenged. Hopkins[1] has described the American plants as a new species, separating them from the Eurasian *A. hirsuta.* In doing so he has emphasized the strongest divergences detectable without, it seems to me, giving adequate consideration to the entire natural variation occurring in plants of either Eurasia or America. Unfortunately, each character emphasized as distinguishing *A. pycnocarpa* from *A. hirsuta* is found to be variable and breaks down as a valid point of distinction when systematically tested on a large series of either American or European plants. This is particularly true when vars. *Eschscholtziana* and *glabrata* are taken into consideration, but was freely found to be the case with populations of var. *pycnocarpa* studied in the field in the Rocky Mountain area.

The distribution of *A. hirsuta* in a general way parallels that of *A. glabra* and it is not disturbing from the geographical point of view to find it widely distributed in both the eastern and western hemispheres. It is true that the American plants show certain tendencies away from the characteristics found in plants of Eurasia, but the resulting differences are by no means of a specific nature. It appears that two alternative courses are open to one treating *A. hirsuta* for North America. The species may be divided into ten or a dozen "microspecies" which do not parallel in the slightest other species of the genus or it may be kept intact as a wide-spread species with the principal variants designated as varieties. Using the more clearly defined species of *Arabis* as a guide as to where specific lines should be drawn in those where complexity often obscures natural boundaries, it is clear that the latter course is preferable.

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[1] RHODORA **39**: 112 (1937).

The application of the name *Turritis ovata* Pursh to an American species of *Arabis*, as shown by Hopkins, l. c., remains unsolved. DeCandolle, l. c., indirectly, and Torrey and Gray, l. c., directly used Pursh's name in a varietal category and this name should have priority over var. *pycnocarpa* if its suspected application could be proved. Under the circumstances it seems best to base the varietal name on plants which are adequately described and represented by a known type. Variety *pycnocarpa* is well illustrated and mapped by Hopkins, l. c., under *A. pycnocarpa*, var. *typica*. A few minor range extensions could be given for the Rocky Mountain region, but this seems hardly necessary since the variety is known to occur widely in the area. Plants of var. *pycnocarpa* have been grown in the greenhouse for three consecutive years without their having flowered. This would seem to indicate that it is often a perennial instead of a strict biennial as formerly supposed.

Var. *Eschscholtziana* was described from specimens collected on the island of Unalaska by Chamisso. The type has not been examined, but there is little doubt as to the identity of the plants. The only other *Arabis* reported from Unalaska is the very different *A. lyrata*, var. *kamchatica*. Var. *Eschscholtziana* is apparently abundant on lower mountain slopes and cliffs at a number of stations from the Aleutian Islands of Alaska to southern Oregon, chiefly near the ocean. The basal leaves of this variety are often large, thick and purplish on the under surface. It intergrades to some extent with var. *glabrata*, but in general the two are distinguishable and occupy separate geographical areas.

Var. *glabrata* was based on a specimen collected in Oregon by Dr. Scouler, but the actual type has either been misplaced or lost. The application of the name to the nearly glabrous-leaved plants from Oregon, Washington, Idaho, British Columbia and nearby areas seems to be sound. Our interpretation differs from that of Hopkins in that we limit var. *glabrata* to the large-flowered plants with diverging pedicels and somewhat saccate outer sepals from the northwestern United States and adjacent Canada. The nearly glabrous types from the Rocky Mountains and farther east do not differ enough from typical var. *pycnocarpa* to be set off from it.

In accounting for *A. pycnocarpa*, var. *reducta*, it may be pointed out that this is the fifth entity described in *Arabis* from North America based on specimens with sterile, semi-sterile or diseased siliques. Partial or complete sterility is a fairly common phenomenon in *Arabis* and has been repeatedly observed in the field in widely separated places. The distinctive characteristics claimed for var. *reducta* are attributable in a large part, particularly in the type specimen, to the diseased siliques, which have only a powdery brown mass in place of normal seeds. The name is considered to have been based on a monstrosity, hence it does not have valid priority over var. *pycnocarpa*.

(*To be continued*)

A STUDY OF ARENARIA PATULA

Julian A. Steyermark

One of the most characteristic spring-flowering species which carpets the limestone glades and barrens of the Missouri Ozarks is the little annual species of sandwort, *Arenaria patula* Michx. Its numerous dainty white blossoms appear in April and May, covering thousands of square miles of rocky surface, and so densely are the areas covered that they suggest natural rock gardens. By June the seed is ripened and the plant dies after this brief three-months' span of activity.

While collecting in the spring of 1939 in an area on Crowley's Ridge adjacent to the lowlands of southeastern Missouri, the writer found plants of this species growing in open sandy ground, a habitat quite unlike the rocky glades and outcrops in other portions of the state. Moreover, all the plants observed were of